TRAPPING INSECTS WITH LIGHT

Student or Classroom Science Project No. 2

OBJECTIVE

To show students how insect traps operate and how insect survey and detection work is conducted.

MATERIALS NEEDED:

1 outdoor extension cord approximately 30 feet long with weatherproof socket
1 40- or 60-watt light bulb
1 transparent plastic container approximately 5 inches high with 3-inch-diameter opening (such as those used to package ice cream)
1 plastic funnel 3 inches in diameter
1 piece of white construction paper 5 inches wide and 6½ inches long
3 pieces of lightweight wire, each 10½ inches long
Masking tape, small nail (4-penny or 6-penny), pair of pliers, one piece of heavy cord about 2 feet long

INTRODUCTION:

Insect traps are widely used by research scientists to collect insect specimens for scientific study or to determine what insects are found in certain areas. In addition, U.S. Department of Agriculture survey and detection teams, working in cooperation with State departments of agriculture, operate insect traps throughout the United States and its possessions to discover any new plant pest infestations which may occur.

Early detection of foreign plant pest invasions—or of the movement of domestic plant pests to another area of the country—is extremely important in the control or eradication of such pests before they become widely established and seriously damage our food, forests, and ornamental plants. For example, a 1956 invasion of Florida by the Mediterranean fruit fly became established, and eradication cost $10 million in Federal, State, and industry funds. The network of fruit fly traps was greatly expanded after this invasion, and when the pest—which attacks citrus and other fruit and vegetable crops—got into Florida again in 1962 it was trapped immediately. Prompt detection resulted in the start of an eradication program. Result: The "Med fly" was eradicated at approximately one-tenth the cost of the 1956 program.

Fruit fly traps are baited with a food lure that attracts the specific insects that survey and detection teams are looking for. Another specific lure is used to trap the gypsy moth, a forest pest confined largely to New England and parts of New York State. Called "gyplure," it attracts only male gypsy moths to traps about the size of paper cups, and scientists do not have to "sort through" a number of other insects to determine whether any gypsy moths have spread into a new area.

Insects are color-blind, but many respond more readily to specific wavelengths of light. Japanese beetle traps use this response. The traps, including a baffle above

the collecting cup, are the correct color to reflect the wavelength of light which attracts this insect to the trap.

These "specific" traps are valuable to regulatory officials who make surveys for particular insects. In addition, these teams and research groups use "general" traps to survey the overall insect populations of an area. One of the frequently used *general* attractants is light, and the light trap which the class will build duplicates in principle the complex light traps used by scientists to survey an area for night-flying insects. Many of these insects are never seen during daylight hours.

PROCEDURE (see diagram):

Hold the nail with the pliers and heat the point. Then burn three small holes through the plastic container approximately ½ inch below the top. Space the holes an equal distance apart around the container. Next, insert the end of the three pieces of wire into the holes, one piece of wire per hole, and bend the ends up inside the container. For simplicity, use lightweight wire easily bent by hand. The wires should be cut off to equal lengths, each approximately 10 inches long. These wires are used to suspend the container beneath the light.

Next, cut the spout off of the plastic funnel with a sharp knife, leaving a hole ½ to ⅝ inch in diameter. Then place the funnel on the container with the plastic rim of the funnel resting on the top of the container. Using two pieces of masking tape, fasten one side of the funnel securely to the container. This forms a hinge, allowing the other side of the funnel to be raised when removing insects from the trap. Use one piece of masking tape to hold the side of the funnel opposite the hinge down securely while the trap is in operation.

Tape the construction paper to the rim of the plastic container on the side where the hinge is located above the holes where the wires are attached, forming a baffle approximately 5 inches wide around one-half of the container and 6 inches high.

Using the wires previously attached to the container, hang the trap below the light bulb which has been screwed into the extension cord socket beforehand. The bulb should be positioned directly over the center of the funnel with the lower end of the bulb approximately 1 to 1½ inches above the top of the container. Tie the piece of cord securely around the socket. This completes construction of the light trap.

DIAGRAM FOR

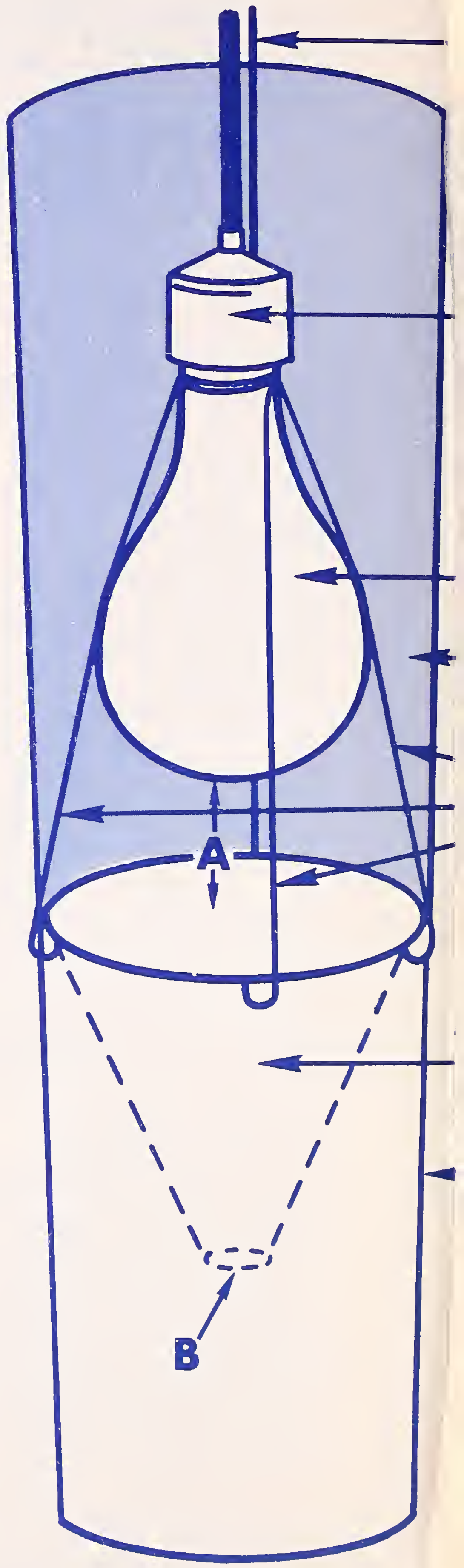

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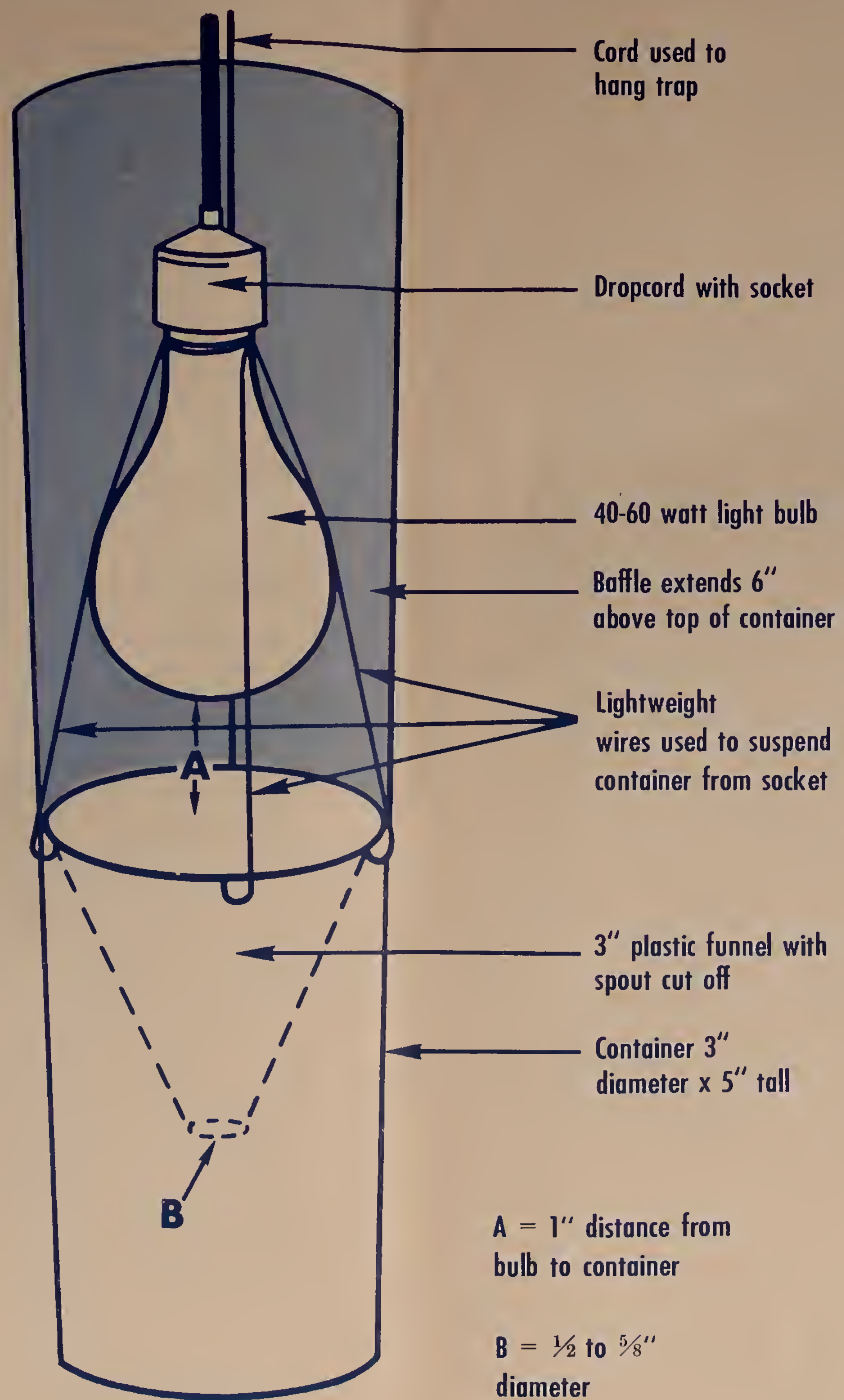
DIAGRAM FOR SIMPLE LIGHT TRAP



OPERATION OF THE TRAP:

Using the cord that was tied to the socket, hang the trap outside the schoolroom window, in a tree in the schoolyard, or in the teacher's or a pupil's backyard. (During early fall or late spring, the light trap will catch insects almost any place outdoors.) Plug the extension cord into an electrical outlet.

Turn on the light at dusk. Larger insects attracted to the light fly toward it, strike the baffle, and fall into the trap. Smaller ones are attracted to the light, fly around it, and many fly into the trap. Within an hour after dark, at least a dozen insects will have entered the trap. Ideally, the trap should be operated all night, but several dozen insects can be collected before midnight if the operator wishes to turn off the light then. About 25 percent of the insects trapped manage to escape; the remainder fail to find their way back up through the opening.

After turning off the light, plug the hole at the bottom of the funnel with cotton or a rag to keep the insects inside until the class is ready to remove them. To remove the insects, simply release the piece of masking tape opposite the hinge and baffle and dump them into a quart glass jar for further observation. Moths that have entered the trap can be so transferred by cupping one hand over the edge of the container and the glass jar to prevent their escape during transfer. Most of the smaller insects will allow themselves to be poured into the jar without attempting to escape.

ADDITIONAL ACTIVITIES:

Once the class has learned to construct and use this simple light trap, construct several and allow pupils to collect night-flying insects in their backyards, orchards, or outside city apartment windows. Compare and catalog the various collections, noting the hours during which the traps were operated, location, type of light used, and number of different types of insects collected.

The ⅜- to ⅝-inch opening in the bottom funnel is a medium size, allowing collection of a wide variety of insects. A larger opening will allow most of the smaller insects to escape, trapping only larger moths; a smaller opening can be used to collect mostly small insects, keeping out the larger moths which often prey on the smaller bugs.

Use different color bulbs and compare results of two traps placed near each other utilizing (1) a clear bulb, and (2) a colored bulb. Blue bulbs will attract some different insects than clear ones. Yellow bulbs

repel most insects (hence, their use in porch lights) but will attract a few.

Some insects eat others while in the traps. Moths often flutter about and lose scales off their wings. For this reason, scientists place a killing agent in light traps so that all specimens will be retained whole.

A simple killing agent which can be used (as long as the pupils are cautioned to avoid drinking it or getting it on their fingers and then putting their fingers into their mouths) is rubbing alcohol. Advanced students desiring whole, undamaged specimens for mounting can use this. A better solution which includes a preservative is compounded as follows: 80 percent ethyl alcohol; 15 percent formalin; 5 percent glycerine. Fill the container to a depth of ½ to ¾ inch, using care to keep the fluid line at least ¾ to 1 inch below the hole in the bottom of the funnel. Remove specimens from the fluid with a toothpick and place them on a paper towel to air-dry.

LEARNING:

The response of organisms to stimuli, including light, is called, "tropism." Response to light is called "phototropism". Insects attracted to light (hence, those that will be caught in a light trap) are those having "positive phototropism". Most moths, beetles, and flies are in this group. Insects that are repelled by light are those having "negative phototropism". Many stored-products pests and most roaches are in this group. Have the class learn these terms and their application to insects.

Different insect species respond differently to various "wavelengths" of light. This is why yellow bulbs repel many insects that are attracted to clear bulbs, and why blue bulbs attract still other insects more effectively. Scientists also use black light (ultraviolet) in some traps to attract specific types of insects that are attracted by a light that humans cannot even see!

Most insects fly around and feed at night, and thousands of different ones exist that pupils have never seen. The light trap offers an ideal way to demonstrate the abundance of insects to be found during an early fall or late spring evening.

Identification of the trapped insects may be undertaken if the teacher chooses to do so. A magnifying glass is needed for the smaller insects, and a simple paperback or textbook on insects showing general features of the various orders and families is best.

Pupils can learn that the insect world is divided by scientists who study insects—called "entomologists"—into a number of orders, which are subdivided into families, and that these families are further subdivided into individual genera and species. For example, moths and butterflies belong to the order, *Lepidoptera;* beetles to the order, *Coleoptera;* bees, wasps, ants, etc., to the order, *Hymenoptera;* and flies, mosquitoes, and gnats to the order, *Diptera* (however, mayflies, dragonflies and similar insects are not "true flies" and belong to other orders). In all, there are 25 different insect orders and each order is subdivided into families, then genera (plural for genus), and finally into various species. All insects belong to the "class" called "hexapoda" which in turn belongs to the "phylum" called "arthropoda". In the entire animal kingdom, there are approximately 15 "phyla" (plural of phylum) including "chordata," where the mammals, including man, fit in. Mites and spiders are in the same phylum as the insects but are placed in another class. Have the pupils learn the meanings, spellings, and relationships between "phylum," "class," "order," "family," "genus," and "species." Pupils can thus learn the overall scientific organization of the animal world and that insects make up 75 percent of all the different species found in the entire animal kingdom!

Young students are generally unaware of the vastness of the insect kingdom and the scope and organization of the natural world around them. This learning, which may be introduced through the light trap, can be their introduction to this unknown world and to the fascinating study of entomology or other natural sciences.

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